SUGGESTIONS CONCERNING APPLE CULTURE

THE SITE FOR AN ORCHARD. THE TREES FOR PLANTING.
CULTIVATION AND COVER CROPS THE GRASS MULCH.
SPRAYING. SPRAY MIXTURES.

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BULLETIN

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NUMBER 137. FEBRUARY, 1903.

SUGGESTIONS CONCERNING APPLE CULTURE.

BY W. J. GREEN.

In the following pages no attempt is made to treat all of the questions relating to apple culture, but simply to touch upon some of the most important of those which have to do with Ohio conditions.

Numerous requests have been made from time to time for a treatise on apple culture, and while it is not thought best to yield to these demands to the extent of giving a full discussion of elementary principles, yet considerable has been embodied which is not new, in order to make more useful the facts which have been brought out by recent experiments.

There has been a great departure from old methods within recent years, and while there is more or less disagreement as to methods, owing largely to varying local conditions, it can be truly said that the best in apple culture is now well founded upon scientific principles. Much has been worked out in recent years by careful experimentation.

It is worth while for apple orchardists to study all that relates to their work, but it is not always safe to adopt new methods without an understanding of the underlying principles. One needs also to study his own circumstances, conditions and environment.

Formerly the advice given to beginners in apple culture did not go much beyond the selection of a suitable site, a congenial soil and the choice of varieties of good local repute. Now, however, market requirements must be taken into account quite as much as the kind of soil, and one should go still further and determine beforehand whether he will ship his fruit or sell in the local market.

It is not only necessary, at present, to study immediate environment, but also to look even beyond one's own state, in order to avoid unnecessary competition with apple growers in sections where the business has been systematized and all of the details carefully worked out, and where facilities for handling, storing and shipping are fully developed.

The steady increase of destructive insects and fungi has made a study of these forms of life necessary, and this has resulted in great progress in methods of protecting the apple crop against

their ravages. This forms an important part of the apple culture of today.

The conservation of soil moisture is now known to be of as much importance as the maintenance of fertility, and how to accomplish both at the same time is a difficult problem; but much progress has been made toward its solution.

Apple crop failures have been so frequent within recent years that many have come to think that only under the most favorable natural conditions can the crop be grown at all, hence the prevalent belief that it is not worth while to take pains in apple culture.

If it were generally realized that good care counts for more in apple culture than do favorable natural conditions, this belief would be less common.

So many causes operate to produce apple crop failures that without care a good crop, fairly free from blemishes, is very rare, perhaps not as frequent as once in ten years. Partial, or inferior crops may be had more often, but only when some of the causes of failure are less operative than usual.

The apple scab, for instance, is usually not seriously harmful when the early part of the season is cool and dry. The codling moth has periods of greater and lesser activity, and sometimes frequent fall rains so swell the size of scattering fruits as to make a good crop, when the promise in the early part of the season was very poor. Favorable natural conditions, however, are exceptional, and unfavorable the rule. The difficulties, nevertheless, increase the opportunities and make profitable orcharding possible to the careful orchardist.

As an instance of what good care will accomplish, the Station orchard may be mentioned. This orchard has been in possession of the Station nine years, and during that period there has been but one crop failure, which was due to a freeze in May. There have been no inferior crops except on the unsprayed portion. All of the trees have borne eight good crops of fine fruit in nine years, except the Baldwins, and even this variety is showing a tendency toward annual cropping.

Several other orchards in the State are known where crop failures do not occur, except through very unusual causes. It is not a matter of unusually good natural conditions in any of these orchards, for in many other orchards, equally well located, inferior fruit and partial or total crop failure is the rule.

The evidence is conclusive that apple failures are due almost wholly to neglect, and it is equally well demonstrated that, with most varieties, annual crops of choice fruit may be secured. There need be no off years, nor any considerable quantity of inferior fruit. These statements are sustained by the results of many experiments and need no qualification, where natural conditions are reasonably favorable.

THE SITE FOR AN ORCHARD.

In selecting a site for an apple orchard it is well to choose elevated ground. Elevation above surrounding areas secures air and soil drainage and comparative freedom from frost. Before spraying was practiced elevation counted for more than it does now in securing fair fruit. Air drainage is often secured by ravines running through or near the orchard. Many good orchards are on level land. This does not disprove the rule, but shows that exceptions may not be disastrous.

A fairly fertile clay loam is about the best for an apple orchard, but the fact that apple trees do well on many different kinds of soil shows that it is not best to emphasize too strongly the importance of choosing any particular kind of soil.

If the soil is too poor to secure a good growth, fertility may be supplied, but to check too rampant a growth and to induce fruitfulness is not so simple a matter; hence a rather infertile soil is to be preferred to one having too abundant a supply of plant food elements.

Exposure, or the direction in which the land slopes, is usually a matter of considerable importance. For winter apples a northern is better than a southern slope. The drying effect of the sun on a southern slope may be somewhat lessened by mulching, but it is easier to manage a northern slope and the results are more certain to be satisfactory. For early varieties a southern slope may be preferable. There is usually but little choice between an eastern and western slope except that the former is usually more fertile.

There are good orchard sites in nearly all parts of the state but they are more numerous in the hilly portions. One is less liable to make a mistake in choosing an orchard site where the land is somewhat hilly or rolling, than where it is level.

Sugar tree, and sometimes beech, oak and chestnut lands are suitable for apple orchards. Elm land is seldom desirable. A soil which will give a good crop of wheat without lodging, if the elevation is sufficient, is usually safe orchard land. The potato crop is usually a safe guide, but the corn crop is less so.

Preparation of the soil for planting must depend upon the after management of the orchard, whether it is to be cultivated or kept in grass, hence this will be considered separately, under the two heads.

THE TREES FOR PLANTING.

Opinions differ regarding the proper size of trees for planting and the age at which they should be taken, but all are agreed that a tree which is one year old at planting will come into bearing at about the same time as an older tree. For various reasons, however, many prefer larger and older trees, mostly because they are more

easily seen and less liable to injury. A tree which is four years old or more is more liable to die in transplanting and more difficult to get into shape than a younger tree. One is not likely to make a second attempt at starting an orchard with large sized trees. If one-year-old trees are chosen, none but the largest and best should be taken. A well grown one-year-old is much better than a two-year-old of the same size. Culls are not suitable in any case. It is better to buy trees by age than by size, but one should understand in doing so that trees of some varieties will be larger than others.

It is not necessary to discuss the relative merits of budded, root grafted and whole root trees. The question of process, or method of growing trees, is one for the nurseryman to consider, not the orchardist. One good tree is of the same value as another good tree, regardless of the process by which the union between root and scion is effected. However, budded trees are larger than grafted trees of the same age, and root gall often develops on grafted trees at the junction of root and scion. This has reference to Ohio conditions, but for different latitudes other questions sometimes enter in.

Likewise, the question of latitude where the trees were grown is not a matter of importance to the orchardist. The Station has planted trees which were grown in many different states, both north and south, and while better trees can be grown in some parts of the country than in others, there does not appear to be any lack of ability on the part of trees to adapt themselves speedily to new climatic conditions. A tender southern variety would not endure a northern climate, but it is not conceivable that a hardy northern variety becomes tender by being propagated and grown in the south a year or two, and as a matter of fact, no difference has been noted in the behavior of trees grown in different latitudes.

The practice of planting some hardy, healthy variety, to be top-grafted later, has some advantages. One can thus be sure of getting the kinds he wants, and in case bearing trees are known which have superior qualities, grafts can be taken from them. Theoretically, this ought to be a great gain, but in practice it is not easy to determine whether a certain superior tree is so because of inherent qualities, which will be perpetuated by budding or grafting, or whether it is so because of some advantage of position or treatment. Bud variation occurs in all classes of plants, but to what extent we are justified in giving it consideration in starting an orchard is a matter yet to be determined. As a working hypothesis there appear to be advantages in adopting the theory that some trees are superior to others of the same varieties, and if such trees are found it is well to propagate from them.

The preparation of trees for planting is a simple matter. One needs simply to readjust the balance between top and root which was disturbed by digging, and if possible, to give the roots some advantage over the top, and to see that so much top is not allowed to remain that the tree will be blown about by the wind. If the top has not been started at the proper height, or is not of the correct form, it may be necessary to start a new top by removing all of the branches. There need be no fear of pruning the top too much. No harm will be done if it is all cut away so as to leave nothing but a mere cane; but, as a rule, it is better to remove such of the branches as are not needed, and to shorten in those remaining. A one-year-old tree would better be cut off at the point where the top is to be started. Of course all mangled roots must be cut off smoothly with a sharp knife. Both top and root may be cut back to mere stubs, as was done when the tree was propagated, but trials of this severe pruning at the Ohio and other Stations do not indicate that it is advisable to follow the plan generally. There appear to be no advantages in it for Ohio conditions.

DISTANCE APART FOR PLANTING APPLE TREES.

The details of laying out and planting an orchard will not be considered here, except the distance apart which it is advisable to to set apple trees. On the Station farm is an orchard, about thirty years old, on quite fertile ground. The trees are 28 feet apart and the branches of many of the opposite trees now touch. The trees are now in their prime but have no more room to develop. There will soon be a falling off in the size and quality of the fruit. Mulching and fertilizing may help for a time, and perhaps severe pruning will have to be resorted to, or some of the trees will have to be removed, which will leave too wide a distance between the rows. On such soil 35 feet is near enough and 40 feet would not be too great a distance between trees. On some soils 28 feet apart would not be too near, and there are many soils in southern Ohio where trees would not touch at thirty years of age even if planted 25 feet apart. The fertility of the land needs to be carefully considered in determining the distance apart to plant trees.

The plan of using fillers seems to have much to commend it before one has tried it. Few of those who have tried it care to do so again. If fillers are to be used it is better to put in double the number that are to stand permanently instead of four times. Where too many are planted they have to be removed before they can be of much service, or harm will result. The permanent trees can be set rather wide apart and the fillers put in the center of each square, but a rather better plan is to plant the trees 18 x 33 feet apart and then when the fillers are removed the trees will stand 33 x 36 feet apart. In practice, however, all plans of using fillers are

found to be very difficult of execution so as to do no harm to the permanent trees.

DRAINAGE AND RIDGING.

Drainage is essential to the life and health of apple trees. If not natural it is best secured with tile drains. A line of tile between every other row is usually sufficient, but more may be needed in some cases. There is little danger of the tiles becoming stopped by roots unless so laid that water and silt can stand in them.

Ridging, or back-furrowing along each row and making a dead furrow between, is not a good plan, as some of the roots are thus covered too deep; moreover the surface soil is taken from the place where it is most accessible to the roots and placed where it is less so. Ridging really lessens the amount of feeding space for the roots and the dead furrow makes places for the water to stand. If the ridging were done before the trees were planted and care taken to carefully grade the dead furrow so that the water would run off without washing the plan would be less objectionable, especially if the ridge were merely high enough to permit the water to run off. At best, this plan admits of surface drainage merely and does not aerate the soil in the the same manner as do tile drains.

MANURING, CULTIVATION AND COVER CROPS.

So much has been said about the necessity for spraying, that there is danger of forgetting that trees need food as well as medicine. There may be sufficient food in the soil, but not available, or the water supply may be insufficient at times, because the soil lacks water holding capacity.

It is chiefly to make plant food available and to prevent the loss of soil moisture that orchards are cultivated. During the first three or four seasons some cultivated crop, such as corn or potatoes, —in fact almost any crop of this kind—may be grown between the trees to advantage. Crops may be grown in a young orchard still longer than this, provided some cover crop is sown each year, or manure applied, in order to keep up the supply of humus.

Wheat, oats, barley, rye or any sowed crop, if allowed to mature, deprive the soil of so much moisture as to affect the trees injuriously, hence such crops should not be grown. It should be borne in mind, however, that while cultivation, if done properly and at the right time, prevents the escape of moisture, it also hastens the decay of humus. To remedy this, also to prevent washing and leaching in autumn and winter, a cover crop should occupy the ground during the fall and winter. Rye is often sown in August or early in September, to be plowed under in the spring before it heads. Oats is a favorite crop for this purpose in some sections. The oat straw mulches the ground and holds the snow in the winter and is not in the way of cultivation in the spring, obviating

the necessity of turning the ground with a plow, as it may be worked with a disk harrow. Hairy vetch, sown late in summer, is satisfactory in some sections. Crimson clover is a favorite crop in some parts, and being a nitrogen gatherer may be alternated with rye or oats. Cow peas and soy beans are particularly useful after regular crops are abandoned. They are sometimes sown broadcast in June or July, but a better plan is to drill them in rather early in the season, leaving sufficient distance between the rows to permit of cultivation. Soil moisture is conserved better in this manner than by broadcast sowing without cultivation. Some good may accrue to the orchard if hay is made of the peas or beans, as much of the value is in the roots, but the good effect of a mulch and retention of fallen leaves and snow is thus lost. To turn hogs in the orchard for a short time after the crop is gathered, to eat the culls and some of the peas and beans, is not a bad plan, if they are not kept in too long.

The fact should not be overlooked, however, that as the age of the trees increases the difficulty of growing an adequate cover crop becomes greater. For this reason it is not best to remove a hay crop of peas or beans from the orchard except, possibly, in the earlier years of its existence. It is evident that no crop can be taken from the orchard, except in its early years, without seriously depleting the supply of humus, and not then on very thin soil. It is better to err on the side of liberality toward the orchard, even in its infancy, for there must come a time when it will be impossible to grow sufficient crops under the wide-spreading branches to keep up a supply of the much needed humus. It is easier to fall below the safety line than to keep above it.

The notion that the soil of an orchard may be cultivated for a number of years, until the vegetable matter is nearly all destroyed, and that it may then be restored in sufficient quantities, by growing cover crops, is a wrong conception. So too, is the idea that the cover crops are grown mostly to furnish food for the trees.

The importance of commencing early in the life of the orchard to fill the soil with vegetable matter ought to be duly considered. It never will be duly considered until it is understood that soil moisture is of prime importance to apple trees; not merely a supply at intervals but all of the time, especially when bearing a crop of fruit.

Humus not only furnishes plant food, but it helps to make plant food available. More important still, in many cases, is its water-holding capacity, thus insuring an equable supply of moisture throughout the season. Insufficient water supply often causes premature dropping of the fruit, and for the same reason, the trees may not be able to perfect a crop of fruit and to form fruit buds at the same time.

THE GRASS MULCH METHOD.

Experiments in mulching show that a lack of a uniform supply of moisture is responsible for several orchard troubles which have been attributed to other causes. It is evident, therefore, that in the management of an orchard the aim should be to conserve moisture and at the same time to grow a crop which shall add to the supply of vegetable fibre. The grass mulch method, seems, under certain conditions, to admirably meet the requirements as to vegetable fibre and soil moisture. It would be premature to attempt to say just what the limitations of the method are, but it appears to be widely applicable, and is especially advisable on hilly land, in fact, wherever cultivation is difficult and on soil which washes and where grass can be made to grow.

To Mr. F. P. Vergon, of Delaware county, Ohio, and to Mr. Grant Hitchings, of Onondaga county, New York, is due the credit of demonstrating that apples may be successfully grown by this method. Both have worked along essentially the same lines for about fourteen years.

Thus far the method has been unqualifiedly successful and merits a description; moreover, considerable misconception concerning it has arisen, hence there is not only danger of some going wrong who may attempt it but many who might adopt it to good advantage may fail to see any good reason for doing so.

Mr. Vergon planted his orchard in a field which had been a blue grass pasture for about fifty years, and at about the same time Mr. Hitchings began planting a young orchard where an old one had stood in grass for about one hundred years. He has also planted an orchard in a field which had been in cultivation for the same length of time, but had been well cared for, and another in a worn out field. Both of these fields have been in grass from the time of planting. Both of these gentlemen dug large holes for the trees and both mulched the newly planted trees. Mr. Vergon made hay of the grass for a few years but soon decided to take nothing from the orchard but apples. He has mulched the trees with the grass and has also hauled in various kinds of material for the purpose. Mr. Hitchings mulches his trees until they get well established and then cuts the grass and lets it lie on the ground where it falls.

The trees in both Mr. Vergon's and Mr. Hitching's orchards began bearing at an early age and have given annual crops. It is especially noticable that the trees are able to carry a crop of fruit and to form fruit buds at the same time, while the fruit is well colored and hangs on remarkably well. Even in dry seasons there appears to be no bad effect from dry weather on the growth of the trees nor upon the size of the fruit. The loss by dropping is insignificant

All of the results which are supposed to come from good tillage and cover crops are found in these orchards in a marked degree.

Are these orchards exceptional cases and do they offer no suggestions of value? The writer has been studying this question for ten years and is free to admit that Mr. Vergon's fifty-year-old pasture field is rather above the average orchard soil in fertility, but not better than many other orchard sites. Two of Mr Hitching's orchards are on land which is above the average in fertility but the third is on worn out soil. The Station orchard is on soil of moderate fertility. It is plain that it is not a matter of fertility alone, and these examples do offer useful suggestions. There is much hilly land within the state where orchards cannot well be grown, except in grass, because of the difficulty of cultivation and the liability to washing. The fact that land is level does not preclude its adoption for orcharding by this method, but the same necessity does not exist for grass as in the case of hilly land. There should be a clear conception in the mind of any one who thinks of attempting the grass mulch method, as to what it means, for failure is likely to result if it is not properly carried out. It does not mean the turning of an orchard out to grass, and allowing the trees to struggle with all sorts of adverse conditions. It is not a slip-shod nor a lazy man's method. It has not been invented in order to save work. It does mean the storing up of humus while the orchard is young, or possibly before it was planted, for its use in old age, like the setting aside of a reserve fund to be drawn upon as needed. It means that the stock of humus shall be continually augmented by the decay of grass, and that if the soil is thin and not capable of producing a good growth of both grass and trees, the fertility must be restored by artificial means. It means that the trees, especially when young, shall not be allowed to struggle for existence, but that the soil about them is to be kept cool and moist and well stocked with fertility by means of a mulch. It means that nothing is to be taken from the orchard but apples. The plan insures the greatest possible quantity of humus during the entire life of the orchard. Theoretically, a soil thus filled with vegetable fibre ought to contain plant food in abundance and to have a water holding capacity sufficient to supply the needs of the trees at all times. Such a blanket of sod with a mat of grass ought to serve as a good non-conductor, keeping the soil cool in summer and preventing deep freezing in the winter. The facts sustain the theory.

Mulches promote the formation of nitrates, and the healthy appearance and long retention of the foliage in autumn of grass mulched trees, indicates a sufficient supply of nitrogen. Doubtless, however, it is the uniform and abundant supply of moisture which counts for more than anything else. Doubtless the even temper-

ature of the soil has a good effect also, but a fuller explanation can wait a more careful study of the matter. The objection has been urged that growing grass robs the trees of both food and water. This is true, as in the case of any cover crop, but whether it takes more or less moisture than other cover crops, has not been determined. Fear has been expressed regarding mice and fire. Mice can be guarded against by heaping earth about the trees in winter or by using woven wire screens. The danger from fire is small in this climate, except early in the spring, or during a very dry time. Doubtless there are some who, realizing the increasing difficulty of growing cover crops, as an orchard becomes older would be glad to change to the grass mulch method. It is more difficult to make such a change than to commence with a young orchard, and the older the orchard the greater the difficulty. It can hardly be done without the use of manure, except on quite fertile soil. It holds true with grass, as with other cover crops, that a good growth must be secured in order to produce a plentiful supply of humus. No doubt it can be done in some cases, but in many it is likely to prove disappointing.

An orchard which has been in grass for some time is more promising. In such a case stock must be excluded and possibly a mulch of some kind spread under the trees, and, if need be, the ground between the trees given a dressing of manure. There are many orchards of this class which might be greatly improved by this treatment. It is entirely practicable, also, to fill vacant spaces in an old orchard with young trees, by mulching them continuously from the time of planting. A part of the thirty-year-old apple orchard at the Station was plowed five years ago. An attempt to grow cover crops was futile, the shade of the wide-spreading branches, and the demands of the roots for moisture preventing a satisfactory growth. The grass on the unplowed portion, however, still retains considerable vigor.

The early history of this orchard is not known fully, but it has been in grass for at least twenty years. Since it came into the possession of the Station, nine years ago, the grass on the unplowed part has been cut and allowed to remain on the ground, except for two seasons when the entire orchard was pastured with sheep. The sheep did not eat the fallen apples on the plowed ground, and not all of those that fell on the grass, preferring to pull those off the branches within their reach, stripping the foliage as well. The grass was kept very closely cropped and both portions of the orchard seemed to suffer from drought. Since the sheep were taken out the grass has been allowed to grow as before, but because of inability to grow cover crops on the plowed portion, a mulch of straw and grass has been applied to the bare ground. It may be necessary to continue this mulch by frequent renewals. The

entire orchard is in satisfactory condition, and apparently might continue to be so if the trees had sufficient room. The plowing of a portion of it would be regarded as a mistake if it had not been done for experiment.

A nine-year-old orchard has been under cultivation, with cover crops, from the start. The soil is rather thin, washes badly and does not grow good cover crops, except rye. The trees are in good condition, but the difficulty of growing cover crops is increasing, the crop of crimson clover now standing in the orchard being too light to give any returns of value. In order to grow cover crops in the orchard manure must be applied, no matter whether cultivation is to be continued or the grass mulch system is adopted. The plan now proposed is to manure well and seed with red clover, timothy and blue grass. The clover will enrich the soil and it, with the timothy, when mown and left on the ground, will furnish material for a mulch, while the blue grass will increase as they decrease. More manure may be needed to bring about this result, however. This plan is outlined to show what it is believed to be a feasible method in case of necessity, as in this instance, where the soil is thin and much inclined to wash. It is not the intention to here recommend the general adoption of the grass mulch plan, but simply to bring it to the attention of orchardists in order that they may study its merits and demerits, and determine for themselves whether it is adapted to their conditions or not. The cultivation and cover crop plan is not adapted to all conditions, and it is hoped that with both methods from which to choose, profitable orcharding may be much more widely extended within the state.

In 1900 an orchard was planted at this Station to test the grass mulch method in comparison with the culture and cover crop plan. In this experiment half of the trees in grass have been mulched and half have been dug about, so as to keep the grass and weeds down in a circle three to four feet across, around each tree. For comparison we have two other plots where the entire surface between the trees is under cultivation. Thus far the results with the grass mulch have been entirely satisfactory. The trees have made a good, healthy growth, the mulched trees being ahead of those in the cultivated plots.

ORCHARD SPRAYING.

The spraying of orchards is a matter of great importance, but must go hand in hand with other essential operations. The full benefit of spraying cannot be realized on orchards when nothing is done but to spray. In fact, the good effects of spraying may be almost wholly lost in neglected orchards. Spraying is not the only thing needful in orcharding, yet it is needful in order to prevent a partial, or entire loss of effort in other directions. Without it there

can be no successful orcharding in this state, at least. There may be occasional good crops without spraying, but not frequently enough to make orcharding profitable. Spraying is a form of insurance, and as such is very profitable. Sometimes it improves the quality of the crop, making it more valuable, and at other times it prevents a partial or total crop failure. Instances have occurred where the crop on unsprayed trees was worthless, while those alongside, which were sprayed, bore fine fruit, worth several dollars per tree. Spraying increases the size of the fruit, it heightens the color, it improves the flavor and very materially adds to the keeping qualities. It also gives the bark of trees a clear, bright, healthy appearance and preserves the foliage from harm, thus promoting the health and longevity of the trees. Spraying costs from ten to twenty cents per tree each season and often gives a net return of from two to five dollars per tree. It is not always profitable, because it is sometimes like new cloth in an old garment. Trees must have sufficient vitality to form fruit buds and be able to secure food and moisture enough to carry a crop of fruit in order to yield returns for spraying.

Then, too, the right materials must be used at the right time and in the right manner. Once in a generation, perhaps, there may be no need of spraying. There have been so many examples of profitable orchard spraying that there is no more reason to doubt its usefulness than to question the value of soil tillage or of fertilization of crops.

All apple orchards within the state need to be sprayed every year for the scab and the apple worm, and some orchards need to be sprayed for the cankerworm, and others for the sooty fungus, and still others for the bitter rot. The same sprayings, however, answer for all necessities, except a few slight variations to be noted.

APPLE SCAB FUNGUS.

The apple scab fungus in a wet season is usually very destructive. It may attack the blossoms and prevent the setting of the fruit; or a little later, it may invade the fruit, causing it to drop or to become seriously deformed. This fungus may harmfully affect the foliage, so that the fruit cannot properly mature and the formation of fruit buds may also be prevented in the same manner. Some total losses of fruit crops are known to be due to the apple scab fungus, and partial apple crop failures occur almost every year from the same cause. Some varieties suffer more than others, but none are exempt.

SOOTY FUNGUS.

The sooty fungus, which causes a smoky or blackened appearance, so common to apples on low lands, is usually present with the

scab, and reduces the market value of the fruit very materially. Both of these diseases are easily controlled by spraying three times with Bordeaux mixture, once before the leaves open and again just after the blossoms fall, and the third time a week or ten days later.

BITTER ROT.

For the bitter rot two or three spraying more should be made. This disease is known to spread from a canker of the limbs. Where this disease is present the bark is dead and shriveled in patches on various parts of the limbs. Limbs having these cankers must be removed in pruning, also rotted apples, known as mummies, which may be hanging on the trees. These precautions, together with thorough spraying, will hold the bitter rot in check.

APPLE WORM.

Treatment for the apple worm is made at the same time by adding arsenite of soda to Bordeaux mixture. Arsenate of lead or disparene appears to be still better, but this is often added to the above, making a combination of Bordeaux mixture, arsenite of soda and arsenate of lead. Our experiments show that arsenate of lead is better than arsenite of soda, hence, the latter can be omitted and more of the arsenate of lead used. Some facts appear to indicate that better results will be secured by using Bordeaux mixture and arsenite of soda together, making another spraying with arsenate of lead. This will increase the cost, but it is quite probable that the arsenate of lead does better work alone than with Bordeaux mixture.

THE CANKER WORM.

For canker worms arsenite of soda in Bordeau xmixture has been less effective than arsenate of lead alone. One application of the latter, before the worms were done hatching, destroyed nearly all of the worms. When applied after the worms were about half grown many of the worms were killed but enough lived to strip the trees of foliage. Thus it appears that, where canker worms are present, it is advisable to make at least one application of arsenate of lead alone, and that before the canker worm eggs are fairly done hatching.

Bordeaux mixture, then, is to be used the entire season; three times for apple scab and sooty fungus, and five or six times in the southern part of the state, where bitter rot may be present. Some varieties of apples, notably the white and yellow skinned sorts, are somewhat injured by too frequent applications of Bordeaux; hence it is well to substitute copper carbonate for the last two or three sprayings. This is rather less effective than Bordeaux mixture and need be used only where it is known that the latter will do harm by causing a russet appearance of the fruit.

DIRECTIONS FOR MAKING SPRAYING MIXTURES FOR APPLE TREES.

BORDEAUX MIXTURE.

Copper sulfate (blue vitrol) 4 pounds.
Quicklime (not air slaked) 4 pounds.
Water, to make 50 gallons,

Dissolve the copper sulfate in about two gallons of hot water, contained in a wooden vessel, by stirring or even better, by suspending the sulfate, contained in a cheese cloth sack, in a large bucketful of cold water. (With the cold water and cheese cloth bag a longer time is required.) Pour the sulfate solution into the barrel or tank used for spraying, and fill one-third to one-half full of water. Slake the lime by addition of a small quantity of water, and when slaked cover freely with water and stir. Pour the milk of lime thus made into the copper sulfate, straining it through a brass wire strainer of about 30 meshes to the inch. Pour more water over the remaining lime, stir and pour into the other; repeat this operation until all the lime but stone lumps or sand is taken up in the milk of lime. Now add water to make 50 gallons in the tank. After thorough agitation the mixture is ready to apply. The mixture must be made fresh before using, and any left over for a time should be thrown out or fresh lime added.

It is a good plan to make a stock solution of copper sulfate by dissolving 25 to 50 pounds at one time. This is easily done by suspending the copper sulfate in a barrel partly filled with water. The sack containing the crystals of sulfate should barely touch the water, for if completely submerged solution takes place more slowly. Also make up a stock of lime paste or putty by slaking the same quantity of lime as of copper sulfate,

AMMONIACAL SOLUTION OF COPPER CARBONATE.

Copper carbonate, 6 ounces.
Ammonia, about 3 pints.
Water, 50 gallons.

Dissolve the copper carbonate in the ammonia and add the water.

Caution:—Use no more ammonia than is required to dissolve the copper carbonate. Ammonia is variable in strength, and the amount required must be tested in practice.

To make copper carbonate:—Dissolve 10 pounds copper sulfate (blue vitrol) in 10 gallons of water, also 12 pounds carbonate of soda in the same quantity of water. When cool, mix the two solutions slowly, stirring well. Allow the mixture to stand twelve hours and settle, after which pour off the liquid. Add the same quantity of water as before, stir and allow to stand the same length of time. Repeat the operation again, after which drain and dry the blue powder, which is copper carbonate.

PARIS GREEN.

In combination with Bordeaux mixture, Paris green may be used at the rate of 1 pound to 175 to 200 gallons of the mixture.

ARSENITE OF SODA.

Dissolve two pounds of commercial white arsenic and four pounds of carbonate of soda (washing soda) in two gallons of water and use one and one half pints to a barrel of Bordeaux mixture (50 gallons)

The easiest way to make the solution is to put both the white arsenic and carbonate of soda in a gallon of boiling water and keep boiling about fifteen minutes, or until a clear liquid is formed, and then dilute to two gallons.

CAUTION—Label this solution as "POISON" as it is colorless.

ARSENATE OF LEAD OR DISPARENE

3 pounds to 50 gallons of water.

Arsenate of lead may be prepared by the orchardist as needed as follows: Arsenate of soda, 12 ounces, Acetate of lead, 33 ounces. Dissolve the ingredients separately in warm water; then mix, and stir well. This is sufficient for 40 or 50 gallons of water It may be used with Bordeaux mixture or alone. For the canker worm and codling moth the best results appear to be obtained by using alone. In considerable quantities the arsenate of lead can be prepared more cheaply than it can be bought, but in small lots the ready made material is the cheaper.